



## Small Scale Irrigation Development

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### Abstract

The country Ethiopia is situated in East Africa and hence agriculture is the base for people's basic fulfillment and the country is abundant by water resource. Even if we have ample amount of water still now rain-fed agriculture is more practiced than irrigation water application. Irrigation can be defined as the application of water to the soil for increasing the moisture content which is important for plant root-growth and development to prevent stress that may cause reduce the amount of yield as well as the quality of the crops.

There is positive relation between irrigation service and poverty alleviation. The availability of water for irrigation in community helps to improve food security. It increases the potential for producing more food consistency in drought prone and food insecure areas.

Small scale irrigation farming has played a vital role in enabling food production by lowering the risk of crop failure and sustaining households and food security status.

Extension works should be done to aware the importance of irrigation system and the involvement of the local farmers could be include when the system is going to be efficient. Government and other related policy formulation organizations should focused on decentralized system among the users.

Irrigation is more effective if all users and non-users participate actually during the planning, implementing, maintaining, monitoring and evaluating works. The participation of the stakeholders is pillar during the management and sustainability of the irrigation structures.

### Introduction

The historical back ground of the country Ethiopia shown that agriculture is the dominant activities to sustain rural community's life and the base for people's basic fulfillment. And also the country has special features to practice agricultural activities because of its geographical and environmental factors [1]. Ethiopia has 111.5 million hectare total land from million hectare is suitable for agriculture. Currently only 16.5 million hectare is cultivated. Due to the variability of rainfall we need irrigation as a supplement for the incensement of productivity.

Water is renewable natural resource which is very importance for any activities done over natural environment. However, when in adequate quantity and quality, it can rather serve as limiting factor in poverty reduction and over all nationally development. therefore imperative that the linkage between water development initiative in agriculture, food, energy, health, education and decentralized governance sectors be clearly understood and carefully managed to benefit from them in proper manner and to minimize or avoid negative cross sectional impact.

From the very beginning irrigation can be defined as an artificial application of water to soil to create the moisture content which is suitable for the growth and development of crops and leach the salts if there is an accumulation of salts in the area that to be irrigated [2]. This activity is done by human to apply water to the crops throughout considering the agro ecology of the irrigated area for improving the rural population's way of life and it has contributed to be agriculture is the driving force of an Ethiopian's economy. Throughout the crop period adequate water is required near the root zone of the plant for their growth during the crop period. The rainfall may not be adequate to fulfill the water requirement, and the intensity of rainfall may not be well distributed throughout the crop season so, irrigation becomes absolute necessary to full fill the water requirement of crops.

Agricultural water management considers all activities in the field like conserve moisture by applying different irrigation mechanisms to meet the labor, land and cost requirement of the system. Irrigation water

management needs an integrated manner from users, policy formation, and extension workers. The irrigation structure is to be sustainable it requires proper design, construction and operation and maintenance. When these interventions could be applied appropriately; farmers would like to solve their problems and improve their economic status.

There is positive relation between irrigation service and poverty alleviation. The availability of water for irrigation in community helps to enhance food security. It increases the potential for producing more food consistency in drought prone and food insecure areas [3]. One of the challenges Ethiopia facing in attaining food security and reducing poverty is high dependence on rain fed Agriculture. The country's economy which has been highly dependent on agriculture is much weakened recurrent droughts. The major problem associated with the rain fall dependent Agriculture in the country is the high degree of variability and unreliability of the rain fall patterns. As a result the current government has placed particularly emphasis on the development and expansion of irrigation land [4]. We now that, the majority of agricultural cropping in Ethiopia are "rain fed Agriculture". There are four major categories of productive use of water in Agriculture: (1) rain fed Agriculture; (2) supplementary irrigation; (3) irrigated Agriculture; and (4) livestock. Irrigation is one of a means to increase the productivity of the agriculture and to meet the food demand of the rural communities [5]. I have to share most writers' idea which was decided that we have no standard and agreed estimation criteria to determine the irrigation potential of the country.

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But according to Awulachew et al. [6], Ethiopia has estimated irrigation potential of 3.5 million hectare during the year 2005-2006; the potential of total estimate area irrigated agriculture in Ethiopia was 625,819 hectares which was the total constituents about 18% of potential, it was planned to expand irrigation development in the country by an additional hectares to the year 2010 [7]. Which constituents about 33% of potential in government policy document irrigation development has already been identified as an important tool to stimulate sustainable economic growth and rural development is considered as a corner stone of food security and poverty reduction [7].

From the history of the country, Small scale irrigation scheme has been normally practiced after the disastrous drought in 1973 to realize food security and to increase the peasant livelihood by producing cash crop. And we try to understand from here is that the practice were included small-scale irrigation up to 100 hectare with a traditional way and modern irrigation scheme up 200 hectare [8]. In 1980 recurring cycle of drought and environmental hazard the need for small scale is highly expanded to address drought and food storage and the need for more food for the interval market [9].

Currently small scale irrigation is highly favored by government as a means of bringing about house hold food security, reduce dependency on food aid economic growth [10]. Through the country has 4.5 million ha of irrigable land, irrigation covers only 0.16 million ha or about 5% of the total irrigable land. The farmers are dependence on rain fed agriculture has made the countries agricultural productivity is extremely low and susceptibility of the variability agro- ecology which leads to limit the productivity and in turn resulted in food shortage.

Small scale irrigation is a policy priority in Ethiopia for rural poverty alleviation and growth, as well as climate adoption; only around 5% of Ethiopian's irrigable land is irrigated. And less than 5% of total renewable water resources are withdrawn annually. Generally the country is predominantly an agrarian and agriculture is the driving force to sustain their life and their basic needs with in directly or indirectly involvement.

This paper would like to show the countries experience on small irrigation practice and its effects on the farmer's way of life.

### History of irrigation in Ethiopia

The Ethiopian agriculture history stated that irrigation was practiced before centuries but the system to apply is much traditional.

Salas [11] in the study conducted to explore whether irrigation was a pillar for the state development and urban development in the early civilization of the country found with inadequate information about irrigation water management and they were tried to understand rain fed agriculture is better [12]. Moreover in the high lands of the Ethiopia irrigation were practiced have long been in use since from the prehistoric time for producing subsistence food crops [6,13]. Bache and Chesworth [13] stressed that supplementary irrigation has been practiced by small holder farmers of Ethiopia for centuries to solve their livelihood challenges. Surface irrigation system was more practiced and which requires much water with a small irrigated area.

### Ways of irrigation development in Ethiopia

From the very beginning we said that irrigation development is much better for sustainable and reliable agricultural development which leads to overall development in Ethiopia [14] noted that irrigation development is a key for sustainable and reliable agricultural development which leads to overall development in Ethiopia. Irrigated

agriculture is being practiced under small holders, medium and large farming. The Agricultural sector it leading in Ethiopia economy, 47% of the total GDP, as compared to 13.3% from industries and 39% from other. At present some 197,000 hectares of land is under irrigation [15]. Irrigation development is a key for suitable and reliable agricultural development which leads to overall development in Ethiopia [14]. Now days irrigation activities to be develop by different ways like the extension workers would like to provide information to create the farmers awareness for the advantage of irrigation system, the government policy could support the system and also state farm and other investment which are using irrigation system is a role model for farmers. Based on the area coverage the irrigation system can be classified as in the following ways.

1. Small-scale irrigation system (<200 hectare)
2. Medium- scale irrigation system (200-300 hectare)
3. Large- scale irrigation system (>300 hectare).

This classification system is the most common in Ethiopia is about 46% of proposed irrigation developments are in small-scale irrigation category [14].

### Irrigation and water resource

**Surface water resource:** The country Ethiopia has 12 river basins however their contribution for irrigation is vary from basin to basin based on different criteria includes the topography, system management, and some basins may have a political issues. From the time being surface water source can be assessed through considering the meteorological data based on the current hydro-meteorological relationships. The concept of river basin needs a dynamic knowledge because the system connected to the well-being of the society [15,16]. It has often been encouraged that the most logical unit for the water resource planning and management should be conducted accordingly; it is desirable that all river basins have its own demarcation, organized master plan and their potential in terms of economic development be known.

In the 1960s and 1970s, a wide-ranging reconnaissance and feasibility studies were conducted on the Abbai (Blue Nile), Awash and Wabe Shebelle river basins. The reports were shown that the river basin is the largest among the other basins and has a potential to irrigate for large agricultural field. Most river basins are trans-boundary and governed by international water management policy and have a political agenda. It is familiar to us small scale irrigation can be performed with in a house hold level while large scale irrigation project would be too costly and needs detailed engineering studies. It argued that without an organized water management program on those basins there would be no predictions' of irrigation development at all.

Surface water source for the irrigation purpose is better as compared as the ground water source because:

1. Mostly ground water contains salt which is not suitable for crop growth
2. Extraction of ground water requires cost and skilled human power depending on the ground water table
3. The sustainability of the ground water is quite problematic
4. The availability of ground water is primarily depend on the nature of the aquifer.

Having on the above reasons' surface water source can be easier

to manage for irrigation activities. Generally all those 12 river basins in the country have its own significant contribution for irrigation development (Table 1).

The main objective of all these schemes has been to determine the water potential, assess the extent and nature of water utilization, and recommend priority areas for the development of surface water resources in the country. The following map shows the special distribution of river basins among the regions of the country with respect to irrigation potential (Figure 1).

**Ground water resource:** As compared to surface water resources Ethiopia has lower ground water potential. Having on the revealing information available on ground water potential is estimated to be about 2.6 BMC (billion meter cube) annually rechargeable resource [17] estimated that at least 13.2 BMC infiltration into the ground water system of which 50% could be extracted.

Agriculture is the driving force of an Ethiopia economy by using 12 river basins water sources and which contains annual runoff volume of 122 Billion m<sup>3</sup> of water and 2.6-2.65 Billion m<sup>3</sup> of ground water potential [6,14]. The numerical estimation showed that the country has abundant water resource. The cultivated agricultural land of Ethiopian currently under cultivation is about 12 million hectare. Even if the potential of the resource is higher which is not meet the actual irrigated area [18]?

In our context ground water source is not available for irrigation purpose rather we use municipal or drinking purpose especially in lowlands of the Afar region and Somalia region by hand dug wells even the ground water table is below 600 m. Depending on the nature of the geology ground water can be dig out and used for different purpose.

### Aim of irrigation

The aim of irrigation is to enable the farmers' to make at most use of the natural resources, water and soil using his or her labor and skill to produce crops (subsistence and commercial) for livelihood. Livelihood includes on farm non-farmer and off farm activities that aims at food security in the first place poverty alleviation, biodiversity, crop diversification and last but not least socio-economic importance of the entire rural community, climate and topography (shape and slope) is to be taken to account [19].

**Small-scale irrigation system:** Small-scale irrigation system in Ethiopia is generally includes traditional small-scale irrigation up to

100 hectare area coverage and [8]. Even if the system has a number of problems, farmers have traditional water users associations, in the form of water communities. In the association the individual farmers have a role for the development of the scheme and are generally well organized and are effectively by farmers. Small scale irrigation system can be apply in all farmers such as growing of vegetables at a house hold level and within a small community by sharing resources and cooperate closely to achieve common goals. The association may comprise up to 200 users who share common canal or its branch. Example of small-scale irrigation include household based rain water harvesting, hand dug well, shallow wells individual house hold-based river diversions and other methods can be used.

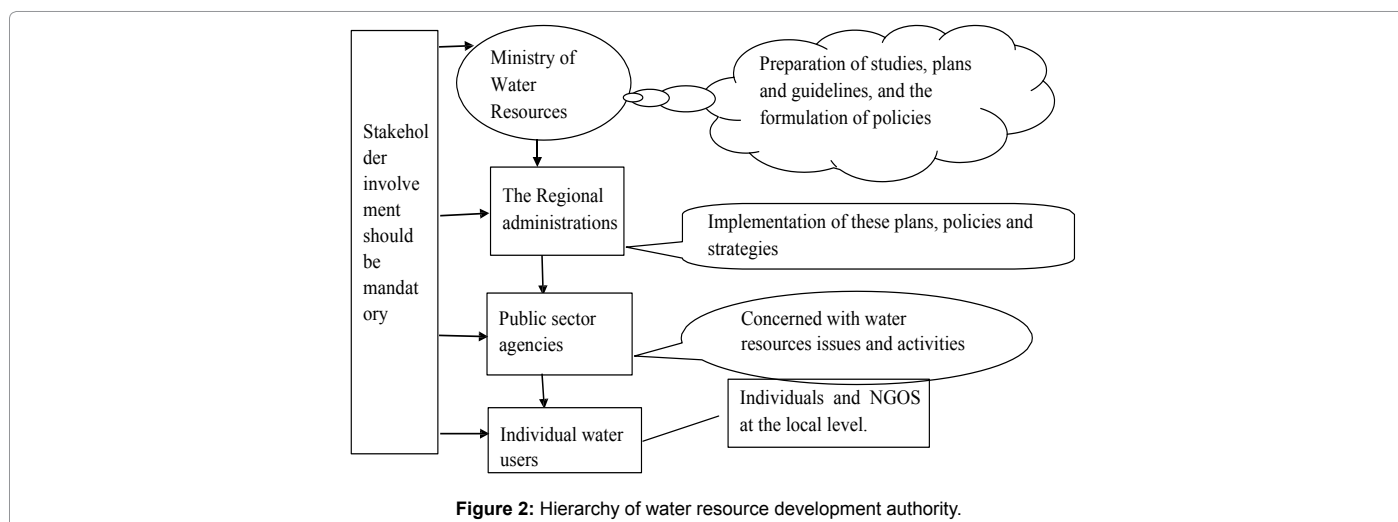
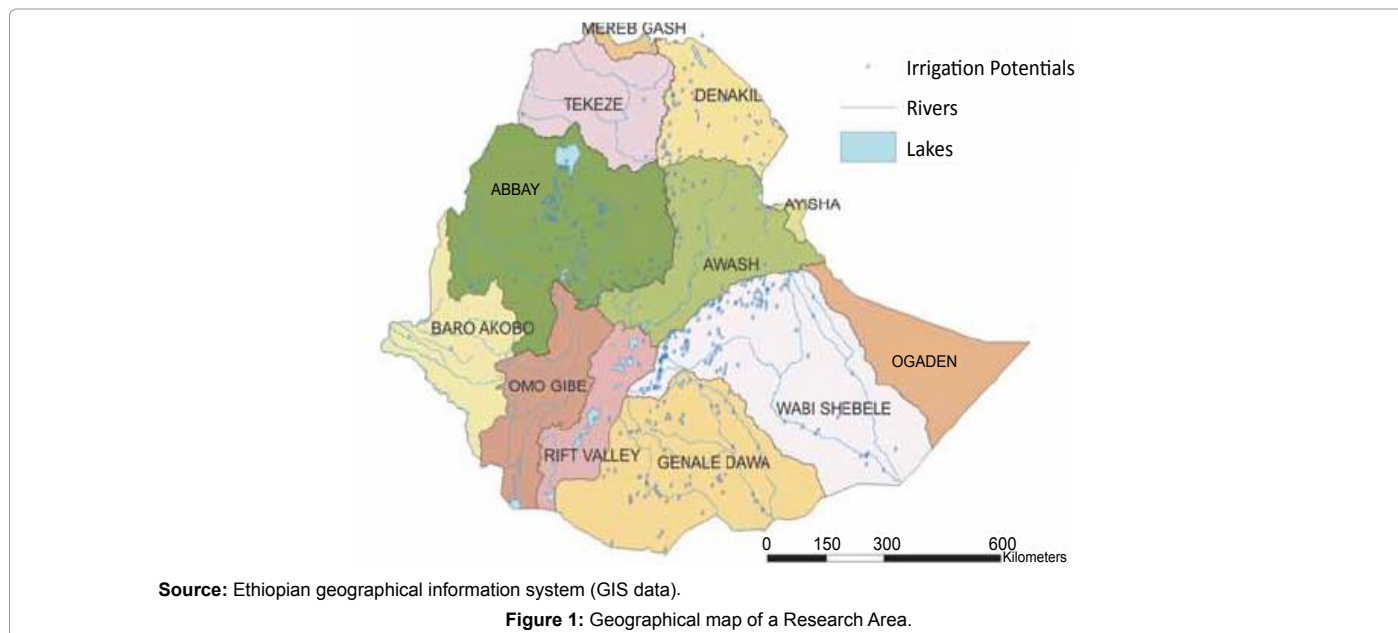
**The development of small scale irrigation:** When small scale irrigation becomes develop in rural areas of the community agricultural productivity to be enhanced. This helps to minimize the dependence and erratic rainfall by providing suitable supply of water by the system to increase food security for the communities. Irrigation development can also improve the quality of the crops which in turn to maximize the human nutritional aspect. Traditionally farmers have built small-scale scheme on Inventiveness, from government aid by (technical and material support), they manage them with in a collaborative and integrated way through their own user associations [8]. The committee is traditionally called "yewhe Dagna" or "yelemat burden".

Traditional practice of small-scale irrigation is made traditionally by building divert ditches at a field level. Earth and stone embankments are built at aside of the river and stream, to gradually left and divers the water on the field, where as modern scheme are characterized by modern conveyance structure [20]. The government has go through its plan to achieve irrigation development by considering the previous target and also modify the system when the scheme is weak. The previous developments target was to put additional 274, 612 ha by 2016 [21]. Its revised target is mainly related to maximize the area coverage as well as to improve the agricultural productivity by including medium and large scale irrigation system. And now days the sector is under the ministers of Water, Irrigation and Energy and it is will also strive similar targets [22].

**Stake holders who participate in small-scale irrigation:** In broad terms, stakeholders including individuals farmers, private or public enterprise, benefactors and water user organization which are concerned with water resources and have an interest in their development. The explanation can be broad or narrow involvement liable on the type of

Basin	Catchment Area (Km <sup>2</sup> )	Irrigation potentials (Ha) (Respective recent master plan studies)				Irrigation Potential (WAPCOS 1995)		
		Small Scale	Medium Scale	Large Scale	Total	Total Drainage Area (km <sup>2</sup> )	Irrigable Area (Ha)	Percent Irrigable Area of the Country
Abbay	198,890.7	45,856	130,395	639,330	815,581	201,346	1,001,000	27
Tekeze	83,475.94	N/A	N/A	83,368	83,368	90,001	3,17,000	8.5
Baro-Akobo	76,203.12	N/A	N/A	1,019,523	1,019,523	74,102	9,85,000	26.5
Omo-Ghibe	79,000	N/A	10,028	57,900	67,928	78,213	4,45,000	12
Rift Valley	52,739	N/A	4000	45,700	139,300	52,739	1,39,000	3.7
Awash	110,439.3	30,556	24,500	79,065	134,121	112,697	2,05,000	5.5
Genale Dawa	172,133	1,805	28,415	1,044,500	1,074,720	117,042	4,23,000	11.4
Wabi Shebele	202,219.5	10,755	55,950	171,200	237,905	102,697	200,000	5.4
Denakil	63,852.97	2,309	45,656	110,811	158,776	74,102	-	-
Ogaden	77,121			-		77,121	-	-
Ayisha (Gulf of Aden)	2,000			-		2,000	-	-
<b>Total</b>	<b>1,118,074.53</b>			<b>3,731,222</b>		<b>982,060</b>	<b>3,715,000</b>	<b>100</b>

Table 1: Irrigation Potential in the River Basins of Ethiopia.



water resource development schemes under consideration. When the project is said to be larger it needs higher number of stake holders' involvement.

From the following schematic representation of the hierarchy of water resource development organization from the higher to lower the stake holders involvement should be mandatory when the project is going to be efficient (Figure 2).

In view of the fact that the above chain of the authority for the development of water resource on the agricultural water management and water supply sense so having on that the stakeholders involvement will have to be somewhat better. While local stakeholders' involvement is lower the development sense becomes nothing since individual stakeholders have a role for sustainable projects. Where private sectors may also be considered as a stakeholder. Top-down approach of the hierarchy will deny the main stakeholders the results become lose the chance to have logic in water resource development activities. The paper thus will emphasis in specific on water users shall said to be *direct* stakeholders to tell apart them from the secondary stakeholders.

Irrigation is more effective if all users and non-users participate actually during the planning, implementing, maintaining, monitoring and evaluating works. The participation of the direct stakeholders becomes the actor to facilitate during managing and governing of any irrigation schemes may be realized in several ways, provisional on the nature of system as well as the size of system. The management committee may be elected by the water users, and they try to organized water users group. From the earlier period peoples were ignored women's participation during irrigation development projects. But female headed household become a gender biased in contradict females have a central role for the development of irrigation water project. Irrigation should have adverse effects among the beneficiaries, if there are not equal and fair distribution resources.

**Gender issues:** Unlike the water supply projects, the irrigation water development projects female involvements are lower. In most rural areas women are the primary water carriers and users. In order to promote small scale irrigation development in Ethiopia have compensated service to gender. Female involvement on the irrigation

water development couldn't be strong enough their active participations can be taken in to considerations. Most writers' were wrote about the women's participation during irrigation development I have to reflect their ideas and I have to decide regarding to the benefit derived from crop production during the household interviews, women were asked openly about their participation as well as involvement in field crop production activities . The answers fell into three categories, no participation, semi-participation and full participation.

**No participation:** This group consists of women who do not work in the fields, almost 20% of the women in the fields. Almost 20% of the women in the sample fall in to no participation category but woman's involvement become indirect like; preparing food for paid workers.

**Semi-participation:** In this group we find women who participate in field activities mainly during peak seasons, when labor is scarce and extra help is needed from all members of the family (for example planting and harvesting seasons). 60% of the women fell in this group.

**Full participation:** Women in this group participate in field activities, every day. Women involvement in decision making regarding the benefits obtained from irrigated agriculture to the amounts of the crop to be sold, the amount to be allocated for home consumption, the way in which the money should be spent etc. women's responses also fell into three groups (Figure 2). Never consulted, 14% of the women reported that they were never consulted by their husbands on decisions. 26% of the women fell in this group. Always consulted, more than half of the woman is shared decision making with their husbands.

Women's has a central role during production process and in some case female headed household to be sustaining their life and to secure food production involvement and participation becomes better. There are a number of limiting factors why females are participating in irrigation water application includes; cultural rules, related to technical skills, the ability to do labor works and so on.

Women there for be involved in the planning, operation and maintenance of rural water supply schemes. The following diagram shows that the scale of female participation for the development of irrigation system (Figure 3).

### Economic contribution of small-scale irrigation to farmer's livelihood

The development of small- scale irrigation scheme has led to increase cropping intensity per year and increase production by supplementing the rain fed production. It also enables the farmers to produce cash crop such as coffee, sugarcane, cotton, banana and mango. Now a day the price of these cash crops grown in the area increase and competitive in the market through time to time and their livelihood improved. And also save extra money by the iqub and in bank and by more ruminant Animals.

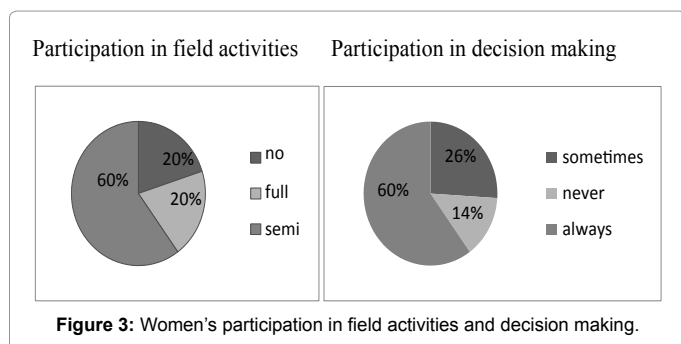


Figure 3: Women's participation in field activities and decision making.

### Assessment or reviewing of irrigation sector in Ethiopia

The modern history of Ethiopia shows that the country has a number of irrigation sectors from small (household level) to large (state controlled level). Small and medium scale irrigation sectors can be practiced in most rural communities of the country while large irrigation sectors are available in middle Awash, Metehara, Wonji, Nura Era, Fincha, Tendaho, Kesem, Kuraz, Tana beles, etc. either commercial or public sponsored projects which is >>3000 ha area coverage.

### Challenges and opportunities of small-scale irrigation

In order to practice the small-scale irrigation system development opportunities and problems can be encourage. The system is going to be efficient hope for the best and use opportunities while facing threat and prepare the worst through minimizing the problems. Having on this the following challenges and opportunities can be occurred.

**Challenges:** The country has been a series of challenges even during good rain seasons and natural failure due to different factors such as pests, erratic rain fall and other environmental constraints. Ethiopia could try to face those challenges in terms of food security is accompanying with in adequate food production to sustain rural communities. Therefor increasing arable land or attempting to increase to promote the food security in the country, we are not expected to agricultural yield alone will promote food security and requires other substantial products to be produced. According to field data records shown that the following are challenges of irrigation development are listed and explained. These are:

1. Shortage of basic technical knowledge of using modern irrigation systems such as drip, sprinkler and spate irrigation systems;
2. Inadequate awareness about how to manage irrigation water with in the field and irrigation scheduling;
3. Inadequate knowledge of an improved and diversified irrigation agronomic practice;
4. During small-scale irrigation development the structure depends on scheme based approach rather than area catchment based;
5. Lack of involvement in design, construction, operation and maintenance of the irrigation projects;
6. The output of the current irrigation schemes becomes low and fragile;
7. In some case problems related to the land owner and other infrastructures;
8. Users Poor economic back ground.

**Opportunities:** The basic opportunities of irrigation development in Ethiopia includes:

1. The growth and transformation plan could a special consideration for the development and growth of the irrigation system;
2. Individual farmers can be practice house hold water harvesting and other irrigation activities through his /her indigenous knowledge;
3. Special consideration for the encouragement of private and public enterprise development who can proposed an irrigation projects;
4. Abundant water resource and suitable environment for growers;

5. Availability of suitable land for irrigation development especially at arid area of the country;

6. Availability of in extensive labor.

### Advantage and disadvantage of small-scale irrigation

**Advantage of small-scale irrigation:** If we manage irrigation activities in proper way it has a number of positive impacts like; generate income, food sufficiency, create employment opportunity, social needs can be self-actualization, increase in agricultural production through expansion and growth of crops, and poverty reduction with in an overall view. Within a wide range of application it is better to determine the merits of an irrigation system in a certain community are to be economically stable, social acceptable, environmentally attractive [23].

The basic purpose of small scale irrigation is to provide water for plant to meet full vapor transpiration their by obtaining optimum yield and maximum water use efficiency. It has been the best option to raise productivity and increase agricultural production and stabilizing agricultural productivity there by providing sustainable development. Generally the benefit of small scale irrigation are both social and economic, some are direct, others in direct, some are assessable and others are in tangible it may also regarded the settlement of lands as social service providing the un employed with livelihood and restoring the self-respect of the individuals. The major advantages of small scale irrigation is the following if irrigation is properly done ;improve farmers income, increase quality as well as quantity of cash crops, eliminate mixed crops, control the time to harvest, over all development and require lower investment costs

**Disadvantage of small-scale irrigation:** Small scale irrigation has disadvantages, if we are not properly done such as: water logging on the surface of land, water paler born disease will be increase, ground water pollution through leaching of, salinity may develop, the management is relatively expensive and more risk of water erosion increase, change in water region of soil, transport of potentially harm full substance to the surface and ground water, damp climate, reproduction for mosquitoes [23].

### Conclusions

Small scale irrigation system management requires labor and other infrastructural inputs with in an integrated way to be efficient. It motivates self- employment of setting full time and part time off farm or nonfarm employment due to efficient utilization of labor. Within a wide range of application it is better to determine the merits of an irrigation system in a certain community are to be economically stable, social acceptable, environmentally sound. This paper reveals that small scale irrigation development in arid and se mi arid areas has advantages to increase cropping intensity, crop production which lead to increase household's income.

Therefore, small scale irrigation farming has played a vital role in enabling food production by lowering the risk of crop failure and sustaining households and food security status. The introduction irrigation agriculture enabled them to produce various types of crop such as teff, tomato, cotton and coffee. Although, small scale irrigated agriculture provides suitable environmental conditions for crop diseases (pest and insect) and human health problems to appear, so practicing different management practice like crop rotation, frequent tillage and use insecticides, pesticide, mosquito net and cleaning the irrigation canal to alleviate the problems.

Generally, reviewing of irrigation water development creates the

opportunity for the household to be diversifying their income base and reduced their dependency on rain fed agriculture that would like to improve food sufficiency status than before the development of small scale irrigation practices. Regardless of the financial and labor constraint, women are also benefiting from the small-scale irrigation practices by producing vegetables and renting their land. Due to well practicing small-scale irrigation, water application problems are improved.

Extension works should be done to aware the importance of irrigation system and the involvement of the farmers could be include when the system is going to be efficient.

Government and other related policy formulation organizations should focused on decentralized system among the users.

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